

**INDIANA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS DIVISION**

**ACCEPTANCE PROCEDURES FOR POLISH RESISTANT AGGREGATES
ITM No. 214-02P**

1.0 SCOPE.

- 1.1** This method sets forth the acceptance procedures to be used when Aggregate Producers request that polish resistant coarse aggregates be evaluated for use in HMA surface mixtures.
- 1.2** Polish resistant coarse aggregates are specified for use under certain traffic ESAL loading conditions to obtain skid-resistant HMA surface courses.
- 1.3** Coarse aggregates tested in accordance with this procedure shall be dolomite containing less than 10.3 percent elemental magnesium, crushed limestone, or gravel.
- 1.4** This method is a two part process. Part One requires a comparison of the coarse aggregate to an approved dolomite material using the British Polishing Wheel in accordance with ASTM D 3319 and the British Pendulum Tester in accordance with ASTM E 303. If the results of the comparison indicate that the coarse aggregate has a British Polishing Number (BPN) of one less than, equal to, or greater than the BPN value obtained from the approved dolomite material, then Part Two may be initiated.

Part Two requires that a test section of HMA using the coarse aggregate and a test section of HMA using dolomite material be placed on a project. The coarse aggregate and dolomite may be blended with air-cooled blast furnace slag, steel furnace slag, or sandstone coarse aggregate for the two test sections. Acceptance of the coarse aggregate is made on the basis of an evaluation of friction test data obtained after two years of exposure to traffic; however an aggregate may be accepted after one year of exposure to traffic at the discretion of the Department.

- 1.5** The Aggregate Producer will be required to maintain a warranty bond on the HMA surface course of the test section using the proposed polish resistant aggregate. The bond amount shall be sufficient to replace the test section with material satisfactory to the Department. Upon opening the test section to unrestricted traffic, the warranty bond will be in effect for a total of two years. The warranty bond must be properly executed by a surety company satisfactory to the Department and be payable to the State of Indiana. Attachment I shall be used for the warranty bond
- 1.6** If within two years of exposure to traffic, the average friction number of the proposed polish resistant aggregate is less than the average friction number of the approved dolomite material, the Department will evaluate the test section to determine if a problem exists. If remedial work is required, the Aggregate Producer shall perform the work at no cost to the Department. If the Aggregate Producer cannot perform the remedial work

within a timely manner, the Department has the option to execute the warranty bond and have the remedial work performed by other forces.

- 1.7** The values stated in either acceptable English or SI metric units are to be regarded separately as standard, as appropriate for a specification with which this ITM is used. Within the text, SI metric units are shown in parenthesis. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other, without combining values in any way.
- 1.8** This ITM may involve hazardous materials, operations, and equipment. This ITM does not purport to address all of the safety problems associated with the ITMs use. The ITM user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 REFERENCES.

2.1 AASHTO Standards.

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| T 11 | Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing |
| T 27 | Sieve Analysis of Fine and Coarse Aggregates |

2.2 ASTM Standards.

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| D 3319 | Test Method for Accelerated Polishing of Aggregates Using the British Wheel |
| E 274 | Test Method for Skid Resistance of Paved Surfaces Using a Full Scale Tire |
| E 303 | Method of Measuring Surface Frictional Properties Using the British Pendulum Tester |
| E 524 | Specification for Smooth Tread Standard Tire for Special-Purpose Pavement Skid Resistance Tests |

2.3 ITM Standard.

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| 207 | Procedures for Sampling Stockpiled Aggregates |
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3.0 TERMINOLOGY.

- 3.1 Terms and Abbreviations.** Definitions for terms and abbreviations will be in accordance with the Department's Standard Specifications, Section 101.

- 4.0 SIGNIFICANCE AND USE.** This ITM will be used to evaluate polish resistant aggregates for use in HMA surface mixtures.

5.0 APPARATUS.

- 5.1** British Wheel, in accordance with ASTM D 3319.
- 5.2** British Pendulum Tester, in accordance with ASTM E 303.
- 5.3** Friction vehicle and instrumentation in accordance with ASTM E 274.
- 5.4** Smooth Tread Standard Tire in accordance with ASTM E 524.

6.0 GENERAL REQUIREMENTS.

- 6.1** Each Aggregate Producer requesting to have a coarse aggregate tested in accordance with this procedure shall do so in writing to the Chief, Materials and Tests Division with a copy sent to the appropriate District Materials and Tests Engineer. Information concerning the type of material, and ledge numbers, if applicable, shall be included.
- 6.2** The approved dolomite material shall be obtained from one of the following sources or a source approved by the Department.
 - 2232 -- Hanson Aggregates Midwest Inc.,
Ft. Wayne, IN (Ledges 1-7)
 - 2267 -- Meshberger Bros. Stone Corp.,
Pleasant Mills, IN (Ledges 1001-4)
 - 2540 -- Mulzer Crushed Stone,
Charlestown, IN (Ledges 102-3, 5-603 (composite))
 - 2598 -- Liter's Quarry
Crestwood, KY (Ledges 2-3)
- 6.3** Testing shall be conducted by a Department approved Laboratory. The cost of shipping and testing of the coarse aggregate shall be the responsibility of the Aggregate Producer.
- 6.4** Friction testing of the test sections will be conducted by the Department at no expense to the Aggregate Producer.
- 6.5** Approval of the source as a Polish Resistant Material will be based on results from both Part One and Part Two of this procedure.

7.0 SAMPLING.

- 7.1** Sampling of the coarse aggregate and approved dolomite aggregates shall be in accordance with ITM 207 in the presence of the Department.

- 7.2 The samples shall be sufficient in quantity to yield a minimum of 50 lbm (20 kg) of material that is passing the 3/8 in. (9.5 mm) sieve and retained on the No. 4 (4.75 mm) sieve.
- 7.3 The samples shall be washed and decanted in accordance with AASHTO T 11.
- 7.4 The samples shall be sieved in accordance with AASHTO T 27 to obtain the appropriate quantity of material passing the 3/8 in. (9.5 mm) sieve and retained on the No. 4 (4.75 mm) sieve required for the test of Part One.

8.0 PROCEDURE.

8.1 CALIBRATION AND TESTING USING THE BRITISH POLISHING WHEEL AND BRITISH PENDULUM TESTER (PART ONE).

8.1.1 Control Specimens.

- a) Control specimens shall be fabricated using a 4 to 1 mixture by weight (mass) of 20-30 grade Ottawa sand and polyester resin in accordance with ASTM D 3319. The back portion of the specimen shall be finished with the polyester resin to facilitate preparation of the bearing surface of the specimens.
- b) The specimens shall be heated in the molds in an oven at a temperature of $230 \pm 9^{\circ}\text{F}$ ($110 \pm 5^{\circ}\text{C}$) for 2 to 4 hours. Specimens shall be shaped to an 8-in. (203-mm) radius of curvature by mechanical clamps.
- c) If the specimens do not properly fit on the road wheel, the bottom of the specimens shall be finished by hand sanding to ensure a proper fit.

8.1.2 Pendulum Calibration.

- a) Two sets of four control specimens each shall be prepared and used to calibrate the British Pendulum Tester. The two sets of specimens shall have average initial BPN values (BPN 0) of 29 ± 1 and 38 ± 1 respectively in accordance with ASTM E 303. These values shall be designated as the benchmark values for the control specimens. At the beginning of each polish resistant test, the control specimens shall be tested. The British Pendulum Tester shall be adjusted until the average BPN 0 values for each of the two calibration groups are within plus or minus one unit from the established averages.

8.1.3 Specimen Preparation and Polish Resistant Calibration.

- a) Specimens shall be prepared in accordance with ASTM D 3319, 8.1.1 b), and 8.1.1 c). A minimum of five specimens each shall be prepared for the coarse aggregate and the approved dolomite material.
- b) Control specimens shall be used to develop consistency in specimen preparation and polishing. Four specimens shall be prepared and included with the test specimens on the British Polishing Wheel. The average of the four control specimens shall have BPN 0 values of 37 to 39 measured in accordance with ASTM E 303. If these criteria are not met, all specimens prepared for the polish resistant test shall be discarded and new specimens prepared.
- c) After polishing for 10 hours, the BPN values (BPN 10) for the four control specimens shall be measured in accordance with ASTM E 303. The average BPN 10 value shall be 28 to 30. If this criteria is not met, the results from the polish resistant test shall not be used.
- d) A control chart shall be prepared and maintained for control specimen BPN 10 values and the corresponding date of test. The average of the four values for each test shall be plotted.

8.1.4 Polishing Machine Tire.

- a) The Polishing Machine tire shall be a smooth-tread, solid (non-pneumatic), tire approved by the Department.
- b) The tire shall be replaced when the BPN 10 values of the control specimens have decreased by more than four points from the BPN10 values obtained from a new tire.
- c) A control chart shall be prepared and maintained for each tire indicating the tire usage hours and the corresponding BPN10 values of the control specimens.

8.1.5 Pendulum Testing and Reporting.

- a) Specimens shall be tested in accordance with ASTM E 303. Broken specimens and specimens with aggregate missing in the slider or contact area shall be discarded. Tests shall be made until four consecutive measurements give the same BPN10 value.
- b) The test value for any aggregate shall be the average from a minimum of four specimens.

- c) If the coarse aggregate BPN 10 value is one less, equal to or greater than the approved dolomite BPN 10 value, the Aggregate Producer may request to proceed to Part Two of this procedure.
- d) Copies of the test information shall be sent to the Aggregate Producer and the Department and shall include the following:
 - 1. Coarse aggregate source identification
 - 2. Type of material
 - 3. Ledges of the aggregate, if applicable
 - 4. Date sampled
 - 5. Individual(s) obtaining sample of coarse aggregate
 - 6. BPN 0 and BPN 10 values for the control specimens
 - 7. Control chart for the BPN 10 values of the control specimens
 - 8. Control chart for the tire usage hours
 - 9. BPN 10 values of the coarse aggregate material
 - 10. BPN 10 values of the approved dolomite material

8.2 TEST SECTIONS (PART TWO).

8.2.1 Test Section Selection

- a) Upon evaluation and approval of the polish resistant data, a project will be selected by the Department for placement of the coarse aggregate and approved dolomite material test sections. The project will have traffic ESAL's equal to or greater than 3,000,000 and have continuous uninterrupted traffic over the test sections.
- b) A 1 mi (1.6 km) test section of HMA using the coarse aggregate material shall be placed adjacent to a 1 mi (1.6 km) test section of HMA using the approved dolomite material. Both test sections shall be placed in the same Driving Lane. The two test sections shall be located between any major intersections on the project.

8.2.2 Friction Testing.

- a) Each test section will be tested by the Department in accordance with ASTM E 274. A smooth tire in accordance with ASTM E 524 and a 40 mph (64 km/h) test speed will be used.
- b) Friction testing will be performed after six months, one year, eighteen months, and two years of exposure to traffic.

9.0 ACCEPTANCE CRITERIA.

- 9.1** If the coarse aggregate HMA friction values are equal to or greater than the approved dolomite HMA friction values after two years exposure to traffic, the material will be approved as a Polish Resistant Aggregate.
- 9.2** The Department will maintain a list of Approved Polished Resistant Aggregates including those aggregates meeting the requirements outlined herein. The list will include two categories as follows:
1. Coarse aggregates that are approved for use in HMA surface mixtures for projects with traffic ESAL's equal to or greater than 3,000,000 and less than 10,000,000.
 2. Coarse aggregates that are approved for use when blended with air-cooled blast furnace slag, steel furnace slag, or sandstone in HMA projects with traffic ESAL's equal to or greater than 10,000,000.
- 9.2.1** Departments list of Approved Polish Resistant Aggregate will be placed on the Approved List with the ESAL category that the project used to approve the aggregate was within.
- 9.3** The Aggregate Producer will be required to have Part One of this procedure repeated every year after the aggregate is placed on the Approved List to determine if any change has occurred in the material composition. The cost of this testing shall be paid by the Aggregate Producer.
- 9.4** The aggregate will remain on the Department's Approved List unless it is determined that the material is not performing satisfactorily.

**POLISH RESISTANT AGGREGATE PRODUCER
ITM 214-02P
WARRANTY BOND**

Know all persons by these presents that we, _____ as principal and _____ as surety, are held and firmly bound unto the State of Indiana (hereinafter referred to as obligee) in the full and just sum of \$_____, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors, and assigns, jointly and severally, firmly by these presents.

The condition of the above obligation is that for two (2) years after the date the test section of HMA pavement located on _____, reference point _____ to reference point _____ is completed and opened to unrestricted traffic; such warranty is to be in accordance with the Indiana Test Method 214-01P (ITM 214-01P) which is made a part of this bond for warranted test section of HMA pavement. If the principal satisfactorily fulfills the above condition, then this obligation shall be null and void; otherwise such obligation is to remain in full force and effect.

(Beginning Point)

(Ending Point)

It is agreed that no modifications, omissions, or additions in or to the terms of the ITM 214-01P or the contract or in or to the plans or specifications shall affect the obligation of the surety on its bond.

In witness whereof, we hereunto set our hands and seal.

Name:

Address:

By:

Signature Surety

Title

(Print or Typed) Surety

State of Indiana, County of _____ SS:

Personally appeared before me,

as surety and acknowledge the executions of the
above bond

this _____ day of _____, 20 _____

By

Signature

Notary Public

(Print of Typed) Notary

My Commission Expires _____, 20 _____

(County of Residence)

Name:

Address:

By:

Signature Principle

Title

(Print of Typed) Principal

State of Indiana, County of _____ SS:

Personally appeared before me,

as surety and acknowledge the executions of the
above bond

this _____ day of _____, 20 _____

By

Signature

Notary Public

(Print of Typed) Notary

My Commission Expires _____, 20 _____

(County of Residence)